A Prototype of Wireless Indoor Surveillance Using Raspberry Pi Robot Car

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ABSTRACT –Using robot cars has been the best choice for surveillance of unrecognized areas. This project proposed a prototype of Wireless Indoor Surveillance Robot Car using Raspberry Pi controlled by smartphone or laptop to enable real time video surveillance. From the test, surveillance monitor was able to capture real time image and also detect the battery remaining power which saved the management cost.

1. INTRODUCTION

Increasing number of disasters and crisis affects millions of lives. Nowadays, robots have been the best choice for surveillance and emergency rescue. A wireless indoor surveillance robot car is a remote controlled car with a wireless transmission features that goes to disaster spots where its activities are viewed through a camera recorded through a laptop. Wireless Sensor Network (WSN) is applied at the post disaster scenario or emergency response to enable interaction between a computer and the surrounding environment [1].

According to Benkhelifa et al. [3], locating emergency responders using mobile wireless sensor networks is efficient in term of sensor information gathering from a mobile anchor. Reddy and Krishna, [4] proposed mobile robot to aid rescue team entering uneven surface areas or explosion spot routes into a coal mines.

The development of motion detection study using Raspberry Pi has been conducted [2,5]. A remote controlled car is built with embedded web server to serve static web using Central Processing Unit (CPU) as a central workstation[2]. A tele-operated mobile robot with wireless control through a customized web user interface is proposed [5] to capture knowledge on the environment through live video surveillance. However, lead acid battery usage increases the power source weight by 500gm for a 2.2 Amp source.

Previous studies [2,4,5] showed that there is no indicator for battery consumption. In the event of a robot placed in a remote place, it is essential to know the remaining power to plan for recharging process. In this paper, a prototype of wireless indoor surveillance robot car using Raspberry Pi was developed for monitoring premises and emergency responders. This paper is organized as follows. Section 2 describes the methodology applied to develop the prototype. Section 3 will show the results and discussion followed by Conclusion in section 4.

2. METHODOLOGY

Figure 1 shows the overall concept design of this project. Raspberry Pi 3 was utilized as a microprocessor to control the robot car movement through a computer or smartphone. The surveillance could be seen from the wireless IP camera that was attached to the robot car. The interface of the robot controller was installed onto a laptop or smartphone and the user would press the buttons or use keyboard to instruct the robot car to move. The instruction and video feed received from the robot car were enabled through wireless connection between Raspberry Pi and the laptop/smartphone.

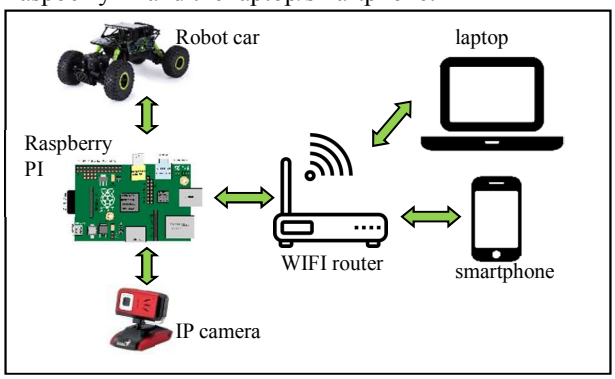

Figure 1 Prototype Concept Diagram

Figure 2 shows the physical design of the Raspberry PI Robot Board controller. This microprocessor would be connected to other equipment such as wireless IP camera, SD card, USB wireless dongle, i298n Dual Controller and Crawler was selected as the robot car. The body of crawler was suitable for the movement, and it could be custom made to the frequency and could also operate using Wi-Fi through laptop or smartphone. To control crawler's movement, i298n Dual Controller was used to control the speed of crawler. The function of this DC motor controller was to control speed of WRC car's front tyre and rear tyre. To visualize image on site, a wireless IP camera had to be installed on the robot car. Analogue to Digital converter was used to check robot car's battery percentage. This monitoring could trace the balance of battery percentage and recharging process could be planned afterward. The SD card was for storage data of the Raspberry Pi code and surveillance capture files. Lipo Battery was used for this project to supply this prototype

which required below 7.2V/2 cells. It was easily recharged, mobile and fit for surveillance project.

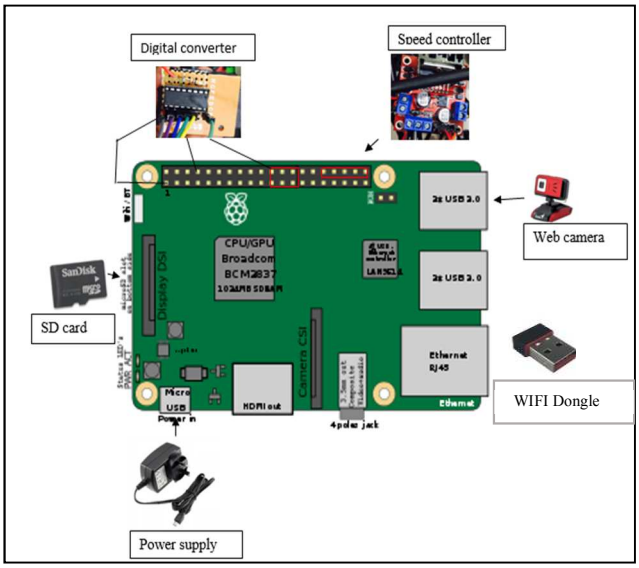

Figure 2 Physical Design of Raspberry PI Robot Car Board Controller with pin configuration

To set up the hardware, all components would be attached based on the pin configuration shown in Figure 2. To set up the software, go to VNC viewer. Enter IP address and click sign in. Desktop of Raspberry Pi will appear prior to login. After the login , the connection should be similar to the computers/smartphone network. Click on connection and connect to the same connection. If the connection is not within the same network, the Raspberry Pi could not communicate to the robot car.

For this project, Python was used and named as MAINGUI.py. The code mainly consisted of the surveillance monitor, and the button movements to control the front and rear tyre of the robot car for each left and right side. There were also reverse and stop function buttons. Capture Button was created to capture the image for record purposes. To monitor the battery, LED-like indicator was set to display the battery percentage.

3. RESULTS AND DISCUSSION

For this study, functionality test was conducted by running the MAINGUI.py file on the Raspberry Pi through the VNC Viewer. All the components were powered up before the Raspberry Pi was boot up. From the test, elements that could be monitored included the robot car movement, captured images and also battery percentage monitoring. Figure 3 shows the surveillance monitor of the robot car. The burning Raspberry Pi board which might occur in [5] did not happen as the LiPo battery which supplied power below 7.2V was utilized. However, during the testing, the wheel gear was unable to move the robot car if the battery power was less than 10%.

Figure 3 Surveillance Screen

4. CONCLUSIONS

The main contribution of the proposed system is the indicator of battery percentage which helps to plan the recharging process. This prototype is also improved using LiPo battery to avoid the burning of microprocessor and also give mobility to the robot car. By using wireless IP camera, information collected by the robot car can be analysed in real time. For future enhancement, IR sensor for night vision and solar to backup the LiPo battery should be added in order to advance surveillance system in cyber physical system.

REFERENCES

[1] A. Bröring, J. Echterhoff, S. Jirka, I. Simonis, T. Everding, C. Stasch, S. Liang and R. Lemmens. (2011). New generation sensor web enablement. Sensors, 11(3), 2652-2699.

[2] A. S. Kumar and P.R. Reddy. An Internet of Things approach for motion detection using Raspberry-Pi. *International Journal of Advanced Technology and Innovative Research*. Volume.08, Issue.19, (2016) 3622 -3627.

[3] Benkhelifa, I., Moussaoui, S., & Nouali-Taboudjemat, N. (2013). Locating emergency responders using mobile wireless sensor networks. *Proceedings of the 10th International Conference on Information Systems for Crisis Response and Management* (ISCRAM).

[4] Reddy, T. K., & Krishna, G. B. S. Hazardous Gas Detecting Rescue Robot in Coal Mines. *Proceedings of IRF International Conference*, 13th April-2014, Chennai, India.

[5] M. Chandrasekaran, A.L. Srinivas, and B.N. Chakravarthy, Wireless Controlled Surveillance Mobile Robot through a Customized Web-User Interface. *Indian Journal of Science and Technology*, 9(33). 2016.